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Growth of the hairy mussel, *Trichomya hirsuta* (Lamarck 1819), from eastern Australia

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Abstract

Hairy mussels, *Trichomya hirsuta*, were held in cages on the east coast of Australia at Townsville, Brisbane, Port Stephens, Lake Macquarie and Eden. Growth rates of the mussels were estimated using the von Bertalanffy equation using length measurements alone and an index of height, length and breadth. The growth rate estimates (K) varied with season and were highest in summer at all sites. Highest growth rates for *T. hirsuta* over a 52 week period were recorded at Lake Macquarie from both length measurements and the index of height, length and breadth. Highest growth rates for the total sampling period were recorded from Brisbane. *Trichomya hirsuta* reached its asymptotic length at Lake Macquarie in 10 to 25 years with growth rates of 2.7–9.0mm/year.

Key Words: hairy mussel, *Trichomya hirsuta*, growth, von Bertalanffy equation

Introduction

The hairy mussel, *Trichomya hirsuta* (Lamarck 1819), is found from Townsville to Tuross on the east coast of Australia, and from South Australia and the Great Australian Bight (Iredale, 1939; Cotton, 1961). The mussel forms thick masses or clumps (Laseron, 1956) which occur on muddy bottoms, sea grass beds and attached to artificial structures (Robinson and Gibbs, 1982). *Trichomya hirsuta* prefers a truly marine environment, but can penetrate into regions of low salinity (Jenkins, 1976). Despite the wide distribution and massive stable populations of *T. hirsuta* which occur in Australian waters, little is known of the biology of this species.

Trichomya hirsuta is reported to have slow growth with pronounced seasonality in Lake Macquarie (Hum, 1971). My study extended these observations and investigated latitudinal and seasonal variation in growth rates of hairy mussels along the east coast of Australia.

Materials and Methods

Mussels were collected 100m offshore at Vales Point, Lake Macquarie, NSW (Fig.1), in approximately 3.5m of water. At this site, mussels form clumps of several hundred individuals on the muddy bottom and were considered to belong to a single population. Mussels between 8 and 80mm shell length were selected from different clumps and tagged using plastic, numbered tags, 5mmx3mm, attached with a cyanoacrylate adhesive ("Loctite" Superfast IS495 Cat. No. 49580) on the posterior of the left valve.

Cages (0.3x0.3x0.75m) were made of galvanised weldmesh (1.6mm wire diameter, 10mm square aperture) with five fibro-cement shelves. The mesh was removed from two shelves to assess the effect of the mesh on growth of the mussels. The mussels on shelves without mesh are hereafter referred to as "uncaged". Sixty tagged mussels were placed on each of the upper four shelves and covered with commercial mussel socking until they attached to the asbestos-cement plates with byssal threads. The bottom shelf was left empty in all cages.

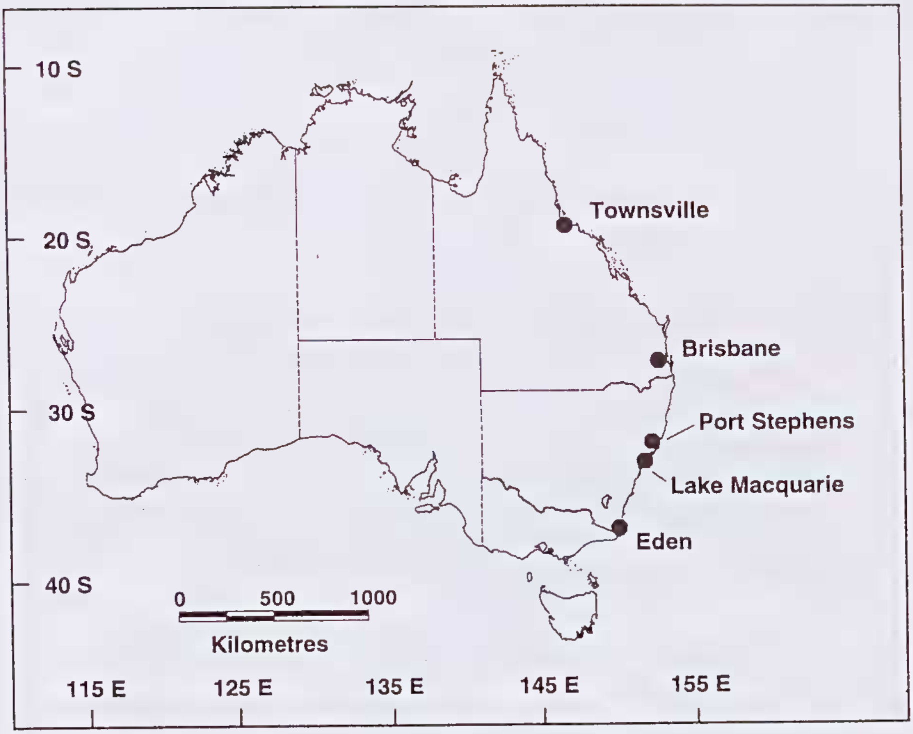

Figure 1. Location of cages with tagged hairy mussels, *Trichomya hirsuta*, along the east coast of Australia

Cages were located at five sites on the east coast of Australia: Townsville, Brisbane, Port Stephens, Lake Macquarie and Eden (Fig. 1). They were permanently submerged at approximately 3m depth and located close to populations of wild, hairy mussels. The cage at Townsville was hung under a commercial tanker wharf; at Brisbane, the cage was attached to a disused oyster lease in a swift flowing channel; at Port Stephens and at Eden, the cages were suspended from an anchored raft; and at Lake Macquarie, it was placed in the inlet canal of a power station. Height, length and breadth of each tagged mussel was measured every 12 weeks, except in Brisbane and Townsville (Table 1) with Vernier calipers to the nearest 0.1mm.

Growth was estimated using von Bertalanffy regression plots of initial length versus length increment. The slope of the regression plot is $-(1-e^{-K})$ where K= Brody growth coefficient (Ricker, 1975) and is a measure of the rate of decrease of growth. The asymptotic length (L_∞) is estimated from the intercept of the regression line with the x-axis.

For all sites, the growth coefficient (K) and asymptotic length (L_∞) were calculated from length data of: caged; and uncaged mussels, and for: each sampling interval; 4 weeks (results not shown) and 52 weeks. The K and L_∞ of caged and of uncaged mussels were compared by t-test when K was at a maximum. The slopes of the regression lines did not differ significantly ($p>0.05$ at all sites), so the results for caged and uncaged mussels from one site were combined in further analyses. K and L_∞ values were re-estimated for periods of 4 weeks and 52 weeks using length data from each sampling interval and the total sampling period. The K and L_∞ values estimated for the total sampling period were calculated using all length measurements which were taken two sampling periods apart. This method estimated growth of mussels more accurately than averaging seasonal growth rates because, in some cases, growth was not detectable over a single sampling period. Growth in mm/year was

Table 1. Asymptotic lengths (L_∞) of hairy mussels, *Trichomya hirsuta*, held in cages at five sites estimated from plot of length increment versus initial length at various sampling dates. TOTAL estimated from all length measurements taken two sampling periods apart.

CAGE SITE	SAMPLING DATES	SAMPLING INTERVAL (weeks)	L_∞ (mm)
TOWNSVILLE	25/5/82–19/8/82	12.3	65.0
	19/8/82–10/11/82	11.9	65.9
	10/11/82–10/2/83	13.1	70.8
	10/2/83–27/4/83	18.9	100.7
	TOTAL	56.2	67.7
BRISBANE	19/5/82–29/9/82	20	72.4
	29/9/82–29/7/83	43	74.1
	TOTAL	63	70.7
PORT STEPHENS	6/6/82–29/8/82	12	75.1
	29/8/82–29/11/82	12	65.4
	29/11/82–13/2/83	12	74.1
	13/2/83–8/5/83	12	82.0
	TOTAL	48	75.6
LAKE MACQUARIE	19/4/82–12/7/82	12	73.9
	12/7/82–4/10/82	12	77.7
	4/10/82–27/12/82	12	63.1
	27/12/82–17/3/83	12	70.8
	TOTAL	48	67.2
EDEN	15/4/82–8/7/82	12	746.5
	8/7/82–30/9/82	12	51.7
	30/9/82–23/12/82	12	57.0
	23/12/82–14/3/83	12	76.6
	TOTAL	48	60.7

calculated from the K and L_∞ values estimated from these data using $dL/dT = K(L_\infty - L_t)$ mm/month.

Height (H), length (L) and breadth (B) were summed for individual mussels to give an index (HLB) which was used to determine K and L_∞ values by plotting change in HLB against initial HLB. These indices were compared to values estimated from length alone.

Growth of the mussels was tested for an exponential phase using a plot of initial length versus length increment. Mussels in an exponential growth phase i.e.below the inflection point of the sigmoid growth curve, generate a positive slope, while at the inflection point there is no correlation, and above this the normal negative slope is generated.

Length versus time of the Lake Macquarie caged population was plotted. This von Bertalanffy plot was generated from

$L_t = L_\infty (1\text{-}e^{-K(t_1 - t_0)})$ (Yamaguchi, 1975)

where L_∞ = ultimate length, K= growth coefficient, t_0= theoretical age at which length is 0 (t_0 was assumed to be 0).

Results were analysed using the Statistical Package for the Social Sciences (SPSS 80).

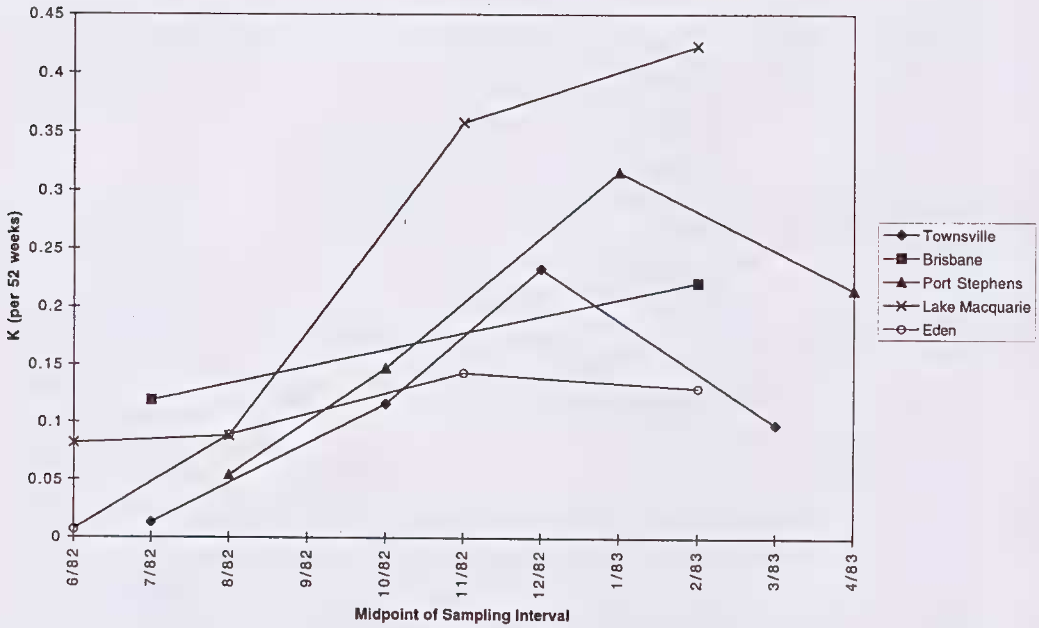

Figure 2. Growth rate (K) estimates for 52 weeks calculated from the von Bertalanffy equation using length (mm) measurements of hairy mussels, *Trichomya hirsuta*, held in cages along the east coast of Australia versus time.

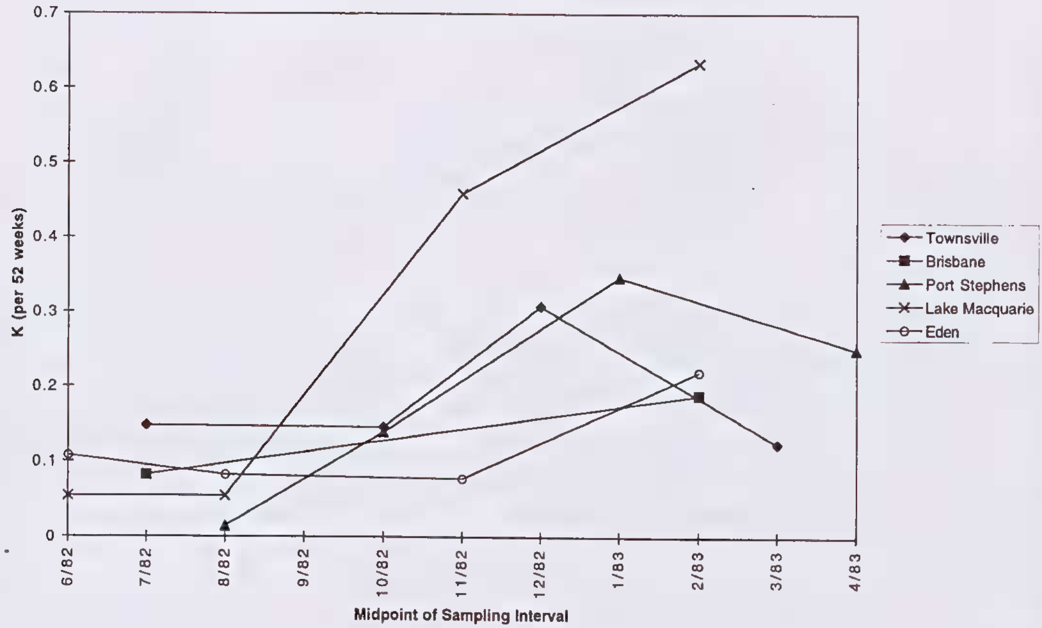

Figure 3. Growth rate (K) estimates for 52 weeks calculated from the von Bertalanffy equation using an index of height, length and breadth (HLB) measurements of hairy mussels, *Trichomya hirsuta*, held in cages along the east coast of Australia versus time.

Results

The von Bertalanffy equation overestimates growth in sedentary marine invertebrates in the early, exponential phase of growth (Yamaguchi, 1975) and therefore is valid only for growth beyond one third of the asymptotic length (Theisen, 1975). There were no mussels from Lake Macquarie found in an exponential growth phase. Mussels at the inflection point were considered to produce a valid point on the curve and were included in further analyses. Thus, the von Bertalanffy equation estimated growth accurately in this population.

Growth rates (K) were highest during the summer at all sites with the highest values recorded at Lake Macquarie (K=0.423 from length measurements; Fig. 2) (K=0.634 from HLB; Fig. 3). The slowest growth in length was recorded in winter at the extremes of *T. hirsuta* distribution at Townsville (K=0.013) and Eden (K=0.007) (Fig. 2) and in an index of height, length and breadth (HLB) in winter at Port Stephens (K=0.014, Fig. 3). Slow growth rates resulted in an overestimation of L_∞ (e.g. Eden for 15/4/82–8/7/82, Table 1).

The highest K values for the total sampling period were estimated from HLB at Lake Macquarie (K=0.634) and from length measurements alone at Brisbane (K=0.205) (Fig. 4).

No significant differences (p> 0.05) were found between predictions of K calculated from HLB (Fig. 3) and those calculated from length alone (Fig. 2), except at Lake Macquarie. There were significant differences (p> 0.05) in growth of breadth of hairy mussels from Lake Macquarie compared with length and height. Length, breadth and height of mussels were changing at the same rate at all other sites.

Smaller mussels grew faster than larger mussels as determined from the plot of initial length versus length increment. A plot of residuals of the regression of initial length versus length increment revealed no trends. The growth of hairy mussels from Lake Macquarie varied with initial length of mussels. Mussels of initial length 10mm grew 8.98mm/year; those at 20mm grew 7.41 mm/year; those at 30mm grew 5.84mm/year; those at 40mm grew 4.27mm/year and those at 50mm grew 2.70mm/year.

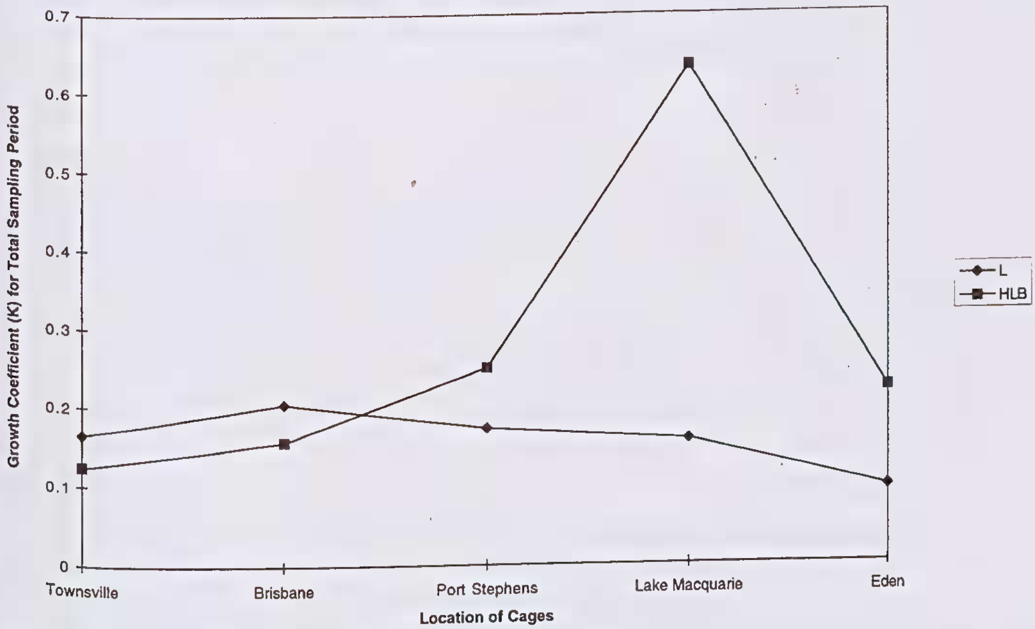

Figure 4. Growth rate (K) estimates for total sampling period of hairy mussels, *Trichomya hirsuta*, held in cages at five locations on the east coast of Australia.

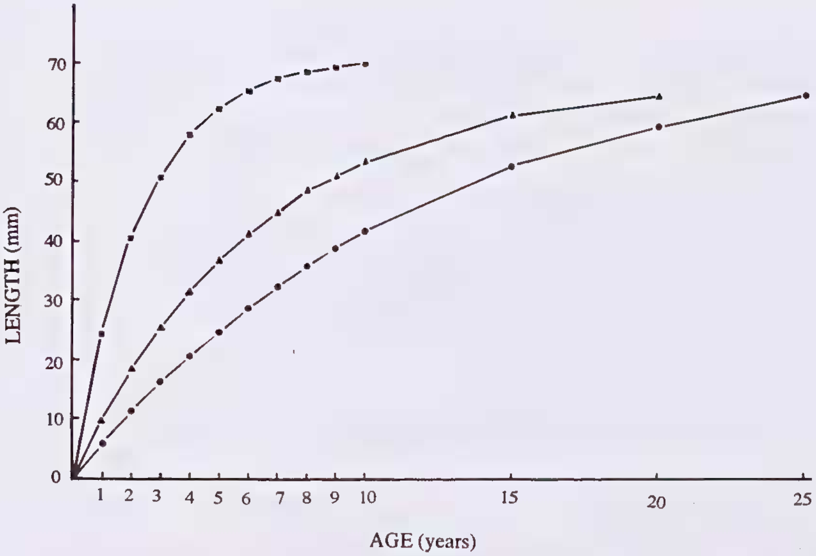

Figure 5. Age estimates from caged, tagged hairy mussels, *Trichomya hirsuta*, from Lake Macquarie. ■ K=0.423, L_∞ =70.8 (27/12/82–17/3/83); ▲ K=0.095, L_∞ =67.2 (total sampling period); ● K=0.082, L_∞ =73.9 (19/4/82–12/7/82).

There were significant initial mortalities at Brisbane and Townsville which decreased over the sampling period (Fig. 5). Mortalities decreased with time at Townsville, Brisbane and Port Stephens and were low at Port Stephens and Eden throughout the experiment. High initial mortality recorded from Brisbane and Townsville cages may result from loss of mussels from uncaged shelves before they were attached and is not considered to reflect mortalities in wild populations. Mortalities were high at Lake Macquarie on the 36 week measurement when the cage was heavily fouled and mussels starved or suffocated under the sediment.

Discussion

Hairy mussels, *Trichomya hirsuta*, grew slowly on the east coast of Australia, with rates increasing in summer. Mussels grew best at Lake Macquarie and Brisbane. Estimates of growth of mussels in Lake Macquarie were similar to estimates made for *T. hirsuta* by Hum (1971) (K=0.26) who also recorded seasonal variation in growth rates for the hairy mussel in Lake Macquarie.

The growth of mussels at Townsville and Eden may have been affected adversely by local environmental conditions: Eden is at the southern, and Townsville at the northern, limit of wild hairy mussel populations on the east coast of Australia. Furthermore, in Townsville, the cage was located under an oil tanker wharf and may have been affected by pollution. In Townsville, low salinities occur during the summer wet season and water temperatures may reach above 28°C (Kenny, 1974) which is the upper lethal temperature for *T. hirsuta* (Wallis, 1976). These conditions are likely to retard the growth of mussels in Townsville and account for low K values during summer.

Trichomya hirsuta grows much slower than the blue mussel, *Mytilus edulis* in Australia and overseas. In Australia, *Trichomya hirsuta* grew slower than *M. edulis* held in cages at the same sites. Body (1983) calculated K values for a 12 week period for *M. edulis* from Eden of 0.08 to 0.58 (c.f. K=0.002 – 0.033 for *T. hirsuta*) and from Port Stephens of 0.07 to 0.26 (K=0.012 – 0.073 for *T. hirsuta*). The highest K values at Port Stephens for *T. hirsuta* were similar to the lowest K values for *M. edulis*. *Trichomya hirsuta* grows at a similar rate in Brisbane (K=0.12 – 0.2) to *M. edulis* in

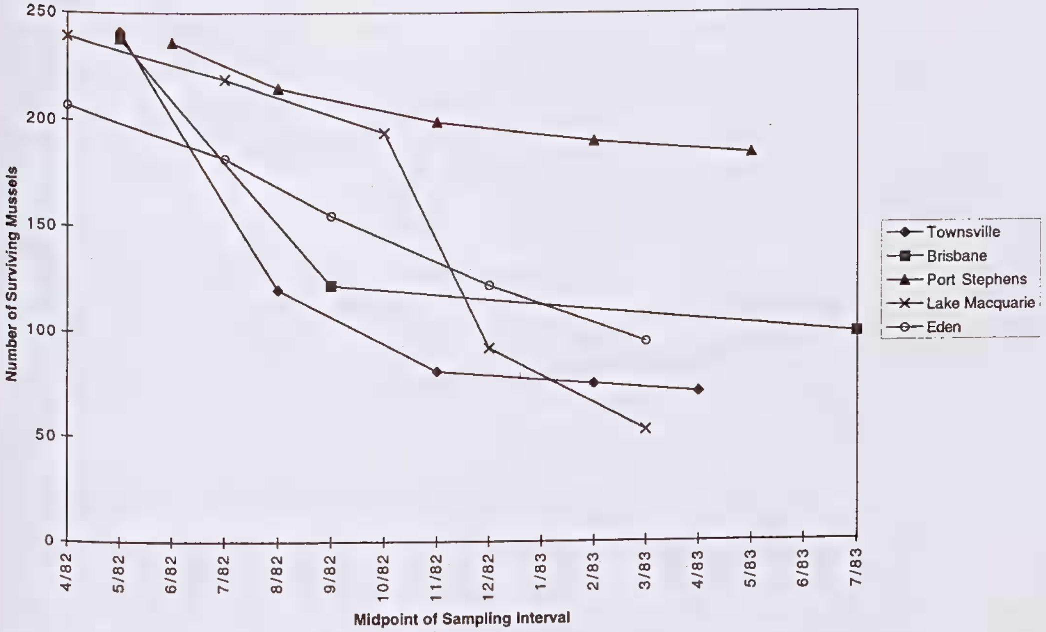

Figure 6. Number of hairy mussels, *Trichomya hirsuta*, which survived in cages along the east coast of Australia with time.

Danish fjords (K=0.14 and 0.97) (Theisen, 1975) and in Townsville it grows at a similar rate (K=0.01 – 0.23) to *M. edulis* in Greenland (K=0.02 – 0.16) (Theisen, 1973).

Growth estimates (K) from HLB did not differ significantly from those calculated from length alone, except at Lake Macquarie, where breadth was growing differently to the other two measures. High water movement at Lake Macquarie and Brisbane did not cause an increase in the growth of breadth of the mussels in the latter site. The cause of the difference in growth of breadth of mussels at Lake Macquarie is unclear. Seed (1973) found breadth often exceeds height in older *M. edulis*. The size of mussels at Lake Macquarie was not different to mussels at other sites.

Caging did not affect growth of *T. hirsuta*. Kautsky (1982) found growth increased from 2.2–3.1mm/year in natural populations of mussels to 15mm/year in his cages. It is possible that *T. hirsuta* in cages in this study grew more rapidly than natural populations because there were lower densities of mussels and they were higher in the water column, than wild populations. Any increase in growth of hairy mussels, however, may be offset by a decrease in growth due to handling (Stromgren,1976).

The von Bertalanffy plot estimated a range of ages for *T. hirsuta* in Lake Macquarie because the growth rate varied with season. *Trichomya hirsuta* reach 50mm long between 4 and 14 years and reach 95% of their asymptotic length between 10 and 25 years. MacIntyre (1959) estimated growth rates of 10–40mm/year for *T. hirsuta* from Lake Macquarie which are higher than estimated in this study. It is possible that MacIntyre (1959) selected small mussels which grow faster than larger individuals and would account for the discrepancy in estimated growth rates. Growth of *T. hirsuta* in this study was similar to mussels in Hudson Bay and Greenland which reached 50mm in 7–11 years (Theisen, 1973). The highest growth rates of *T. hirsuta* were similar to those of *M. edulis* on exploited mussel beds in Europe which reach 50mm in 2–4 years (Theisen, 1973).

Trichomya hirsuta grows slowly with pronounced seasonality on the east coast of Australia. The highest growth rates of the hairy mussel occur in the middle of its range with rates decreasing toward the limits of its distribution.

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